DISEASES OF THE LYLLID AND CONJUNCTIVA OF THE DOG

by

JACOB LUCETE MOSIER

D. V. M., Kansas State College
of Agriculture and Applied Science, 1945

A THESIS

submitted in partial fulfillment of the

requirements for the degree of

MASTER OF SCIENCE

Department of Surgery and Medicine

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1948

KANSAS STATE UNIVERSITY LIBRARIES

2668
.T4
1948
M67
c.2

TABLE OF CONTENTS

INTRODUCTION 1

MATERIALS AND METHODS 2

ANATOMY AND PHYSIOLOGY 4

The Eyelids 4

The Conjunctiva 8

PATHOLOGY 9

Follicular Conjunctivitis 9

Catarrhal Conjunctivitis 10

Purulent Conjunctivitis 13

Ectopia of the Gland of Harder . . . 14

Blepharitis 14

Surgical Diseases 15

Tumors of the Eyelids 17

EXPERIMENTAL PROCEDURE 21

Pathological Studies 21

Transmission of Follicular Conjunctivitis . 22

Bacteriological Examinations 23

Examination for Inclusion Bodies . . . 29

Miscellaneous Etiological Studies . . . 30

Therapeutic Experiments 31

Medicinal Dyes 33

CONCLUSIONS 33

ACKNOWLEDGMENTS 36

LITERATURE CITED 37

INTRODUCTION

The most common diseased condition of the eye of the dog encountered in veterinary medicine is follicular conjunctivitis of the membrana nictitans. According to Nicolas (1), it has been estimated that 40 percent of the dogs are affected with this condition. The fact that ten out of ten dogs checked at random by the author in one day were affected with follicular conjunctivitis would tend to indicate that the incidence is much higher.

Many cases are undetected due to the absence of abnormal secretions. The majority of cases are discovered following a complaint by the owner of a continuous catarrhal or mucoid discharge from the eye.

An extensive search of available literature was made for a description of the pathology and for information concerning the etiology of follicular conjunctivitis. Brumley (2) described the granulations as a swelling of the lymph follicles with underlying connective tissue proliferation. The lack of detailed information on the pathology, etiology, and treatment of follicular conjunctivitis prompted these investigations.

In an effort to make this manuscript of more practical value, some of the more common diseases of the conjunctiva and eyelids will be discussed along with the resume on follicular

conjunctivitis.

MATERIALS AND METHODS

With a few exceptions, the animals used in these investigations were dogs which were brought to the Kansas State College Veterinary Clinic as homeless strays. A few were privately owned animals which were presented to the clinic for treatment.

To determine the pathological changes involved, the membranae nictitans were removed from the eyes of seven mongrel dogs. Of these, two were normal and the other five were representative of the different stages of development of follicular conjunctivitis.

Immediately following their removal, the tissues were placed in Zenker's solution. The technique used for preparing the mounted slides consisted of the following steps.

1. Preparation of material
    a. Fixed in Zenker's fluid for 12 to 36 hours.
    b. Washed in running tap water for 24 hours.
    c. Hardened and dehydrated in 80 percent alcohol for at least 4 hours.
    d. Hardened and dehydrated in 95 percent alcohol for 24 hours.
    e. Hardened and dehydrated in 100 percent alcohol for 8 hours.
    f. Cleared in oil of cedar for 12 hours.

g. Infiltrated in tissue mat bath for 24 hours with a change of tissue mat in the middle of the period.

h. Imbedded in tissue mat.

2. Sectioned on rotary microtome.

3. Mounted individual sections on microslides, covered with a thin film of Mayer's albumen fixative.

4. Stained sections with alum hematoxylin alcoholic eosin method.

5. Sections mounted in clarite.

The sections were then studied under the microscope.

The work on determining the etiology of follicular conjunctivitis was hampered by the lack of dogs with unaffected membranae nictitans. In fact, out of 45 animals, all of which were strays, only 3 were unaffected. These 3 were all less than three and one-half months of age. The first 2 were litter mates and were used to secure normal lids for the histological studies. The last one was used in an attempt to transmit the condition.

Using sterile technique, the eyes of 5 dogs were swabbed and the secretions cultured on blood agar plates. Epithelial scrapings of the follicles were made on five cases and stained by different techniques in a search for possible inclusion bodies.

In the miscellaneous etiological experiments, massive doses of vitamin A were administered per os to two cases. Another two affected animals received an anti-allergy, anti-

histamine preparation per os.

Therapeutically, the efficacy of crystalline copper sulfate and that of the gauze technique was compared in three cases. On six additional cases, the effects of different medicinal dyes were tested.

ANATOMY AND PHYSIOLOGY

The Eyelid

The main eyelids, otherwise known as the palpebrae, consist of freely movable cutaneous-conjunctival folds. They are composed, from without inward, of skin, loose subcutaneous fascia, muscular tissue, tarsus and fascia, and conjunctiva. Within these tissues, there are numerous glands, blood vessels, lymphatics, nerves, and projecting outward along the free margin of the upper lid are the cilia or eyelashes.

The integument is very thin and is provided with small, very fine hairs. Small sebaceous and sudoriferous glands function to keep the skin soft and pliable. The areolar tissue, which attaches the integument to the muscular layer is loose in texture and practically devoid of fat. These features are conducive to the formation of edematous swellings following irritation or injury.

The muscles of the eyelids, Sisson (3), Miller (4), are principally striated and include the orbicularis oculi, corruga-

tor supercilii, malaris, levator palpebrae superioris, retractor palpebrarum, and Muller's muscles. The orbicularis oculi muscle is located in and around the eyelids and functions to close the eyelids. The corrugator supercilii arises from the supraorbital process and spreads out to blend with the orbicularis oculi muscle. Its action is to assist in raising the upper eyelid. The malaris arises in the fascia in front of the orbit and acts to depress the lower lid. The levator palpebrae superioris extends from the pterygoid crest to the upper lid and acts to elevate the upper lid. The retractor palpebrarum arises from the temporal fascia and inserts in the lateral canthus of the eye. It acts to lengthen the palpebral slit when the eyelids are closed. Muller's muscles are nonstriated involuntary muscles inserting into the medial margins of the tarsal plates and membrana nictitans. Little is known of their actions except that they are involved in the protrusion and retraction of the membrana nictitans.

The tarsus is the frame work or skeleton of the lid. It is composed of dense fibrous tissue and its oblong form corresponds to the shape of the eyelid. The tarsus in the upper lid has approximately twice the breadth as that in the lower lid. The tarsi are attached, by means of the tarsal ligaments, to the lateral walls of the orbit and to each other by means of the palpebral ligament.

The palpebral conjunctiva is closely adherent to the tarsus and will be described in the discussion of the conjunc-

tiva.

The anterior margin of the upper eyelids bear short, stiff, curved hairs termed cilia or eyelashes, which are absent on the lower lids of most dogs. The cilia function as a means of protection for the eyeball.

Maximow and Bloom (5) list the named glands associated with the main eyelids as the glands of Moll, the glands of Zeis and the Meibomian glands. The glands of Moll are modified sweat glands located within the margin of the eyelid and their ducts open into the hair follicle, on the surface of the skin or into a duct of the glands of Zeis. The nature of the secretion of the glands of Moll is not known. The glands of Zeis are sebaceous glands and are closely associated with the follicles of the cilia.

Imbedded in the tarsus are the Meibomian glands which secrete a fatty substance known as palpebral sebum through their excretory ducts on the margin of the eyelids. This secretion serves to prevent the overflow of tears onto the external surface of the eyelid. The Meibomian glands are elongated, parallel to one another and perpendicular to the margin of the eyelid. In the upper lid they number 35 to 40; in the lower, 30 to 35.

The membrana nictitans or third eyelid is formed by a semilunar fold of conjunctiva and is situated at the medial canthus of the eye. The conjunctiva covers and partially en-

closes the wide thin portion of the hyaline cartilage which forms the skeleton of the membrana nictitans. The cartilage has an irregular outline with the base, which is thick and somewhat prismatic, embedded in the periorbital fat at the medial side of the eye. This portion of the cartilage is surrounded by the glandular tissue of the Harderian gland which functions as a supplementary lacrimal gland. When the eyeball is in its natural position only the thin marginal portion of the membrane is visible. Attached to the cartilaginous framework are bundles of smooth muscle which form one group of Muller's muscles.

The palpebral opening, or fissure, is the interval between the margins of the two lids. The union of the upper and lower lids at each corner of the fissure form the angles or canthi of the palpebral opening. The actual joining of the lids is known as the commissure. Both the canthi and commissures are referred to by their position as medial or lateral.

The arteries supplying blood to the eyelids are, chiefly, branches of the superficial temporal and the ophthalmic and infraorbital branches of the internal maxillary. The blood passes back towards the heart through corresponding veins. The sensory nerves arise from the ophthalmic and maxillary divisions of the trigeminus. The motor nerves include branches from the facial and oculomotor nerves and the sympathetic fibers to Muller's muscles. In general the nerves enter the

orbital cavity at its posterior aspect and the vessels either accompany the nerves or are subcutaneous along the dorsal border of the zygomatic arch.

The eyelids protect the eyes from external injury, undue exposure, external irritants, foreign bodies and excessive light. They serve as an agent for spreading lacrimal fluid over the exposed surface of the eye, thus keeping the surface of the cornea moist, lubricating the eyeball and washing away any foreign particles which may have entered the eye.

The Conjunctiva

The conjunctiva is a thin layer of mucous membrane which lines the internal surface of the eyelids and is reflected on to the eyeball to form the conjunctival sac. The conjunctival sac is the space between the lids and the eyeball, which is open or closed in front depending on the position of the eyelids.

Three divisions of the conjunctiva are distinguished. The palpebral conjunctiva is that portion which forms the inner lining of the eyelids and the epithelial surfaces of the membrana nictitans. The bulbar conjunctiva is that portion which lies directly on the sclera of the eyeball and is continued on the cornea to form its first or epithelial layer. The fornix or sacular portion unites the two previous parts and is folded to allow for movement of the eyeball.

According to Maximow and Bloom (5), the epidermis of the conjunctiva is stratified columnar in character and varies only in thickness in the different portions. Spherical goblet cells are scattered among the superficial cells. The lamina propria of the conjunctiva varies from dense connective tissue in the palpebral portion to extremely loose connective tissue with fine elastic fibers in the bulbar conjunctiva. Numerous lymphocytes and plasma cells are found in the lamina propria of the palpebral and fornix portions.

The bulbar conjunctiva approaching the corneal limbus assumes a stratified squamous epithelium and is continued as such on to the cornea. Around the corneal limbus its cells contain numerous pigment granules.

Physiologically, the conjunctiva performs a dual function. It is a means of protection against infection and irritation, and its glandular cells secrete a lubricating substance which is essential to a healthy eye condition.

PATHOLOGY

Follicular Conjunctivitis

Follicular conjunctivitis is an inflammation of conjunctiva characterized by the appearance of lymph follicles on the inner aspect of the membrana nictitans. The etiology of this condition is not known and there is some debate as to whether

the appearance of the follicles is pathological or physiological.

Frumley (2) suggests irritation and distemper as possible causative factors. Nicolas (1) pointed out that the conditions must be physiological because of the large percentage of dogs affected. Muller and Glass (6) consider that follicular conjunctivitis is a chromic form of catarrhal conjunctivitis. Sharp (7) states that the condition is principally confined to the young and is said to be infectious. Hawk et al. (8) attribute the hypertrophy of the lymph follicles of the conjunctiva of humans to a deficiency of vitamin A.

Nowhere in the literature could a detailed description of the pathological changes be found. The symptoms, if present, consist of a catarrhal, mucoid, or purulent discharge, depending on the chronicity of the condition. Treatments varied from collyriums to actual cautery with silver nitrate or copper sulfate. Brumley (2) advises removal of the membrana nictitans in advanced cases.

Catarrhal Conjunctivitis

Catarrhal conjunctivitis is characterized by a continuous ocular discharge and a reddening of the conjunctiva. It may be classified as acute or chronic depending on the character of the discharge and the condition of the conjunctiva. In the acute form, the discharge is thin and watery and the conjunc-

EXPLANATION OF PLATE I

Fig. 1. Photograph of the inner aspect of the membrana nictitans of a dog which has been treated for follicular conjunctivitis.

Fig. 2. Photograph of a membrana nictitans showing a well developed case of follicular conjunctivitis.

PLATE I

Fig. 1.

Fig. 2.

tiva is edematous. In the chronic form, the discharge is more mucoid in character and the conjunctiva is seemingly dry. Quite often, the hair falls out around the margin of the eyelids and medial canthus due to the irritation of the discharge.

Covault (9) mentions dust, plant pollens, and wind as possible causes. Other factors to be considered are foreign bodies, chemical irritants such as soap and medicinal substances, distemper, allergy, bacterial infections, parasitism, and poor nutrition. Treatment consists of collyriums, cold packs, and ophthalmic ointments. Hot packs are usually contraindicated as they raise the temperature of the cul-de-sac, thus stimulating the growth of bacteria.

Purulent Conjunctivitis

Purulent conjunctivitis is characterized by swollen eyelids, a purulent discharge, and edema of the conjunctiva. It is usually acute although chronic purulent conjunctivitis is not uncommon following distemper, severe cases of mange and eczema, or in animals kept under poor hygienic conditions. Purulent conjunctivitis, which is caused by a pyogenic bacteria, may be a primary or a secondary infection. It most frequently develops in cases of distemper, but may develop from foreign bodies or catarrhal conjunctivitis. The chief danger of purulent conjunctivitis lies in the fact that the irritating exudate may bring about devitalization of the cornea and result

in the formation of corneal ulcers.

Treatment consists of removing the underlying cause as well as relieving the immediate condition. Ophthalmic ointments and collyriums constitute the best therapy.

Ectopia of the Gland of Harder

Tusak (10) describes the displaced gland of Harder as a rounded body, one-fourth to one-sixteenth of an inch in breadth, and flattened before backwards protruding above the free margins of the membrana nictitans. The cause of this condition is not known, however, Nicolas (1) states that there is an hereditary tendency towards it. Quite frequently it is associated with chronic conjunctivitis. It is most common in spaniels, bull dogs, and Boston terriers. The condition is also referred to as displacement, tumefaction or luxation of the Harderian gland. Surgical removal is the most common method of treatment.

Blepharitis

Blepharitis is an inflammation of the eyelids which, if not treated, may lead to abscess formation. Muller and Glass (6) classify blepharitis as: blepharitis superficialis, an inflammation of the skin of the eyelid; blepharitis profunda, an inflammation of the cellular tissue of the lid; and blepharitis

ciliaris, an inflammation of the lid margins. The etiology of blepharitis is quite variable. Bruises, mange, eczema, fungus infection, exposure to cold winds and water, puncture wounds of the eyelids, and an extension of conjunctivitis are the most common etiological factors. Treatment consists of removing the cause of the condition.

Surgical Diseases

There are a group of diseases of the eyelids which may be classified as surgical diseases; that is, they are treated by performing surgery. Entropion, ectropion, ankyloblepharon, trichiasis, and districhiasis are the major surgical diseases of the eyelid of the dog. Entropion is an inversion of the eyelid towards the cornea. It often results from chronic conjunctivitis or blepharitis, cicatrization of wounds, and mange. The tendency towards entropion is considered to be hereditary. Entropion produces keratitis, conjunctivitis, and suppuration. If allowed to pursue its course, it may lead to the loss of sight due to opacity and ulceration of the cornea.

Ectropion is just the opposite of entropion in that it is an eversion or turning out of the eyelid. It is normally present to a certain degree in some breeds of dogs such as bloodhounds, St. Bernards, and Pointers. It may result from lacerations, abscessation, and cicatrization of the lids. Because of its position and lesser curvature, the lower lid is most frequently involved.

Ankyloblepharon is the adhesion of the margin of the upper eyelid to the margin of the lower eyelid. It is normally present in new born puppies and persists until the puppies are 10 to 15 days of age. At this time the eyelid margins separate and the lids function normally. If the adhesions are still present 21 days after birth, a pathological condition exists which is known as ankyloblepharon. In most cases there is a small line or groove at the point were separation should occur. Treatment consists of making a small incision through the lid at the lateral canthus, inserting a grooved director, and continuing the incision along the line of separation to the medial canthus. After treatment consists of frequent instillations of a two percent solution of boric acid and applying vaseline to the lid margins to prevent further adhesions.

Trichiasis is an abnormal position or direction of the eyelashes. It may be congenital or acquired. Principal symptoms are lacrimation, inflammation and ulceration of the cornea, and blepharospasm. Trichiasis and entropion are coincidental.

Districhiasis is a condition in which there is a second row of eyelashes growing out of the ducts of the Meibomian glands. These abnormal lashes are directed against the eyeball and cause severe irritation. Treatment consists of removing the abnormal eyelashes by plucking.

The most satisfactory method of treating entropion,

ectropion, and trichiasis is to perform surgery. It is not necessary to discuss the surgical procedure as they are adequately described in most textbooks. Eastman (11) mentions the following important points of technique in the surgery on entropion and ectropion:

1. Do not encroach too near to the free margin of the eyelid.

2. Avoid digital manipulation or soiling of the wound.

3. Do not suture too tightly.

4. After suturing, apply gentle pressure by means of a dry swab to express retained blood.

Tumors of the Eyelids

Brumley (2) describes several types of tumors found on the eyelids of dogs. He lists papillomas, chalazions, pilosebaceous cysts, enlargements of the Glands of Moll, granulomas, and malignant neoplasms. With the exception of chalazions and pilosebaceous cysts, the treatment of choice in tumors of the eyelids is surgical removal. Treatment of chalazions and pilosebaceous cysts consists of incising the enlargements and removing the contents followed by swabbing the cavity with an antiseptic solution, or excision of the affected gland. Occasionally the expression of the contents by pressure will open the duct and effect a cure.

A chalazion or meibomian cyst is the result of a retention

of the secretions of the meibomian glands. Lowenstein, according to Urbach and Gottlieb (12), advances the theory that chalazions are caused by repeated resorption of the secretion of obstructed meibomian glands. He believes that such resorbed material may act as an endogenous allergin and that the chalazion constitutes a local allergic response. It is generally accepted, however, that the immediate cause of chalazions is an obstruction of the ducts of one of the meibomian glands.

EXPLANATION OF PLATE II

Fig. 3. Cross section through the tissues of an enlarged Harderian Gland showing the areas of tumefaction.

A. Glandular tissue
B. Connective tissue
C. Tumefied areas
D. Tissue debris

Fig. 4. Photograph of the eye of a cocker spaniel with a congenital malformation of the membrana nictitans. The membrana nictitans covers the anterior half of the eyeball.

A. Membrana nictitans
B. Pigmented areas

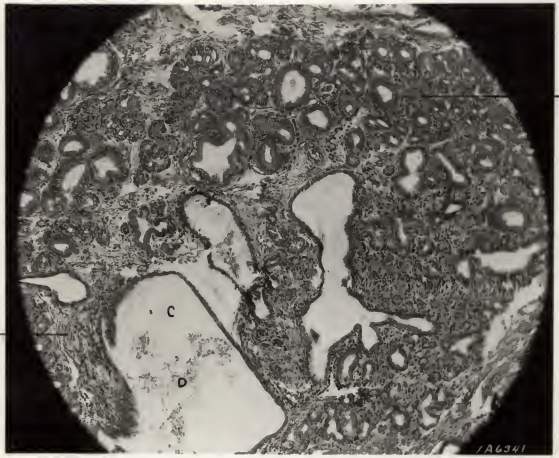

Fig. 3.

Fig. 4.

Plate II

EXPERIMENTAL PROCEDURE

Pathological Studies

Dogs #1 and #2. Mongrel terriers, females, age two months. The eyelids and conjunctiva were carefully examined. There was no abnormal discharge or other evidence of disease. The conjunctivas were anesthetized with a two-percent solution of Butyn Sulfate and the membranae nictitans removed. The tissues were then prepared, mounted, and stained according to the technique described in the section on materials and methods. Examination of the mounted sections, Plate III, Fig. 5, revealed no cellular infiltration of the subconjunctival tissue and no evidence of lymph follicles on the medial surface of the membrana nictitans.

Dogs #3 and #4. One mongrel collie, male, three months, and one mongrel cocker, female, aged two months. There was a slight catarrhal discharge present at the medial canthi of the eyes, and the inner surface of the membranae nictitans presented a few hardly discernible follicles. Microscopically, Plate III, Fig. 6, the lamina propria of the conjunctiva was infiltrated with lymphocytic cells. An occasional lymph follicle could be found in the lamina propria. The condition was representative of an early form of follicular conjunctivitis.

Dog #5. Mongrel shepherd, male, age five months. There was a mucoid-catarrhal discharge from both eyes. The membrana

nictitans was hyperemic, rough, and granulated on its inner aspect. Microscopic examination, Plate IV, Fig. 7, revealed numerous, well developed lymph follicles in the lamina propria of the conjunctiva. The follicles were definitely rounded and were composed of lymphocytes, plasma cells, and an occasional eosinophil. There was a slight increase in the connective tissue. A diagnosis of subacute follicular conjunctivitis was made.

Dogs #6 and #7. Mongrels, male, full grown. Objectively, there was a mucopurulent discharge from the eyes. Examination of the membrana nictitans revealed a dark red granulated conjunctiva on the medial surface of the membranae nictitans. The bulbar conjunctiva was reddened and its vessels injected. Under the microscope, there was a considerable increase in the amount of connective tissue underlying the follicles. The line of demarcation between the follicles and connective tissue was very distinct, Plate IV, Fig. 8. The cellular structures of the follicles were the same as in dog #5 with the exception that there was considerable tissue debris and beginning necrosis near the center of the follicle. The pathological changes were representative of chronic follicular conjunctivitis.

Transmission of Follicular Conjunctivitis

Dog #1. Mongrel terrier, male, three months. Examination of the membrana nictitans did not show the presence of the

follicles of follicular conjunctivitis. The follicles of an advanced case of follicular conjunctivitis were scraped with a sharp scalpel. An emulsion of the scrapings was prepared by adding them to 10 cubic centimeters of sterile saline. The inner surface of the right membrana nictitans of dog #1 was scraped with a scalpel until hemorrhage occurred. The emulsion of the tissue from the affected dog was then placed on the scarified area and massaged into the tissue.

The left membrana nictitans was simply scarified and used as a control. Both eyes were examined daily. On the fifth day, small follicles began to appear on both the left and right membrana nictitans. These results can be explained in one of two ways. Either the follicular conjunctivitis was incidental and would have developed anyway, or the scarification of the membranae nictitans caused the development of the follicles. Since this experiment was made, none of the animals examined have been free from follicular conjunctivitis and consequently no further experiments have been made.

Bacteriological Examinations

Five mongrel dogs of mixed breeding and of undetermined ages were used in this study. All five cases showed definite follicular conjunctivitis. The discharge from the eyes varied from catarrhal to mucopurulent. Cotton-tipped swabs were prepared and sterilized in the autoclave. The cul-de-sac of each eye was swabbed and the material cultured on blood agar plates.

After a forty-eight hour incubation period at thirty-seven degrees centigrade, three of the plates were negative for bacterial colonies. Two plates showed bacterial growth. Two types of colonies were present in one plate and only one type in the second plate. Smears were made and stained with the Gram technique. Hemolytic streptococci were present in both cultures and staphlyococci could be found on one of the blood agar plates. The culture in which both streptococci and staphlyococci were present was from the patient showing muco-purulent discharge. The discharge from the patient in which streptococci alone was found was more mucoid in character.

EXPLANATION OF PLATE III

Fig. 5. Cross section through the tissues of a normal membrana nictitan.

A. Conjunctiva
B. Glandular tissue of Harderian Gland
C. Cartilage

Fig. 6. Cross section through the tissues of the membrana nictitans from a dog showing a slight catarrhal discharge from the eyes.

A. Conjunctiva
B. Lymphocytic infiltration
C. Beginning of a lymph follicle
D. Glandular tissue of Harderian Gland

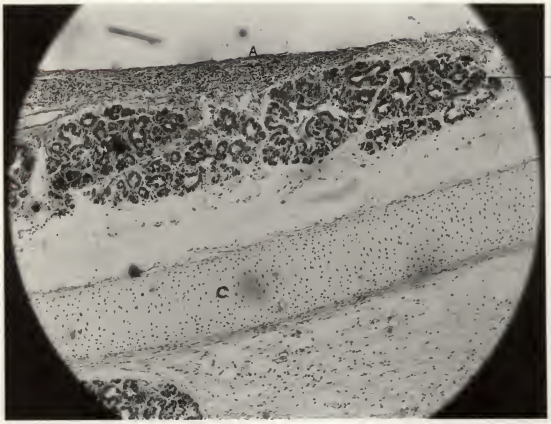

Fig. 5.

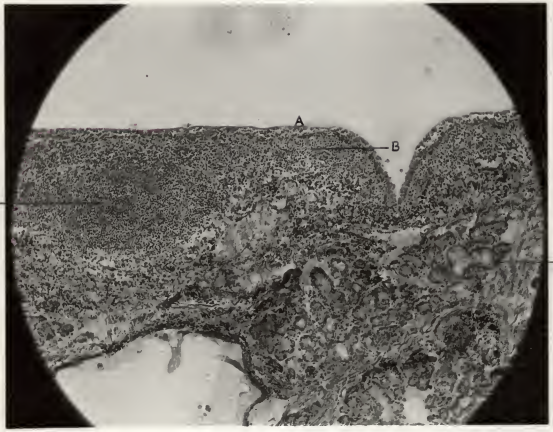

Fig. 6.

EXPLANATION OF PLATE IV

Fig. 7. Cross section through the tissues of the membrana nictitans of a dog showing well developed lesions of follicular conjunctivitis.

A. Conjunctiva
B. Lymph follicles
C. Connective tissue
D. Glandular tissue of Harderian Gland

Fig. 8. Cross section through the tissues of the membrana nictitans of a dog affected with a long standing case of follicular conjunctivitis (Note the increase in connective tissue).

A. Conjunctiva
B. Lymph follicles
C. Connective tissue
D. Glandular tissue of Harderian Gland

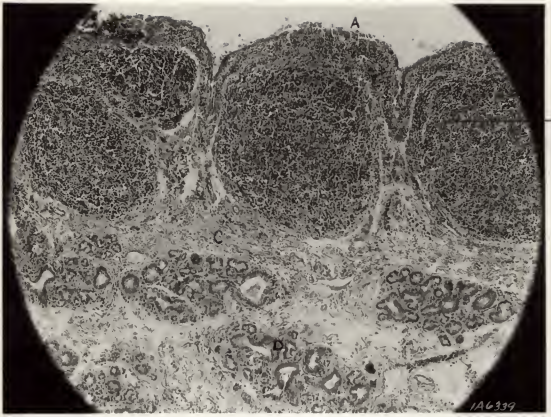

Fig. 7.

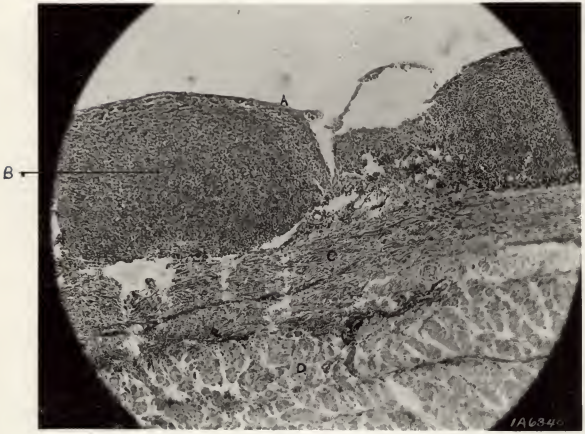

Fig. 8.

Examination for Inclusion Bodies

Epithelial scrapings of the follicles were made on five mongrel dogs which were affected with follicular conjunctivitis. The scrapings were placed on glass slides and stained. Two slides were made for each type of staining technique.

Babies Stain (Basic fuschin and methylene blue). The prepared slides were fixed in methyl alcohol for five minutes, washed thoroughly, and stained for one minute in a filtered solution of seven cubic centimeters of methylene blue, one cubic centimeter of basic fuschin and fifty cubic centimeters of distilled water.

Trichrome Stain (Pollak's). The prepared slides were fixed in Zenker's solution for one hour. They were then washed and passed through a series of preparations consisting of iodized alcohol for seven minutes, ninety-five percent alcohol for three minutes, five percent aqueous sodium thiosulfate for twenty seconds, tap water for four minutes, and Harris' hematoxylin stain for six minutes. Following this, the slides were washed in tap water and stained for twelve minutes with trichrome stain. The final steps consisted of washing in tap water and clearing in alcohol.

Giemsa Stain. The scrapings on the glass slides were fixed for ten minutes in methyl alcohol. They were then stained over night in the incubator at thirty-seven degrees centigrade with

Giemsa stain diluted one minim to each cubic centimeter of neutral distilled water. The following morning the slides were decolorized for five seconds in ninety-five percent alcohol.

Wright's Stain. One cubic centimeter of Wright's stain was placed on the prepared glass slide for three minutes. Then one cubic centimeter of distilled water was added to the Wright's stain already on the slide. This was allowed to remain on the slide for three and one-half minutes and the slide was then washed in distilled water.

Rice's Stain. Smears from follicular conjunctivitis were fixed in ninety-five percent alcohol. Several drops of Lugol's solution were then placed on the slide and covered with a thin cover slip.

Examination of the above prepared slides under the microscope did not reveal inclusion bodies in the epithelial cells. If found, the presence of inclusion bodies in the epithelial cells would have indicated a possible virus infection.

Miscellaneous Etiological Studies

Dogs #1 and #2. Mongrel shepherds, females, three and one-half months of age. Both animals were affected with follicular conjunctivitis. They were given, per os, fifty-thousand units of vitamin A daily for a period of ten days. The membranae nictitans were examined on the tenth, fourteenth, and twenty-first days after the first day of treatment. In so far

as it was possible to tell with the naked eye, the administration of vitamin A did not affect the course of the disease.

Dogs #3 and #4. Dog #3 was a female, adult, mongrel terrier weighing 18 pounds. Dog #4 was a male, six months old, mongrel cocker weighing 22 pounds. Both dogs were affected with acute follicular conjunctivitis. Both dogs were given fifty milligrams of the anti-allergic, antihistaminic preparation, Benadryl, three times daily for two weeks. The membranae nictitans were examined every third day, and at no time did the administration of "benadryl" demonstrate any effect on follicular conjunctivitis.

Therapeutic Experiments

Three dogs, affected with follicular conjunctivitis, were used in an experiment to determine the comparative value of crystalline copper sulfate and that of the gauze technique in the treatment of follicular conjunctivitis. In all three cases, the right membranae nictitans were treated with copper sulfate, and the left membranae nictitans were treated with the gauze method.

Procedure. The eyes were anesthetized with a two percent solution of butyn sulfate. The free margin of the membrana nictitans was grasped with a pair of forceps and the inner surface exposed. On the right membranae nictitans, a clear blue crystal of copper sulfate was used to cauterize the

granules. After the granules had turned grayish in color, the membrana nictitans and conjunctiva were irrigated with sterile saline to remove the excess copper sulfate. On the left membranae nictitans, the granules were rubbed with a piece of gauze until hemorrhage occurred.

Ten days later the membranae nictitans were examined and in all three cases, those treated with crystalline copper sulfate were almost smooth. In two cases, there were one or two small follicles remaining and in the third case, no evidence of follicular conjunctivitis could be seen. Those treated by the gauze method, while greatly improved, still retained an average of four follicles each.

The results obtained in this experiment indicate that crystalline copper sulfate is the more satisfactory treatment.

Two mongrel male dogs, affected with an early form of follicular conjunctivitis, were treated by dropping three minims of one percent solution of copper sulfate in glycerine into the cul-de-sac behind the membrana nictitans once daily for five days. The administration of this preparation was followed by severe lacrimation for approximately one hour. The membranae nictitans were examined on the third day following discontinuation of the treatment and in both cases, the follicular conjunctivitis had disappeared. Witter (13) has used one and two-thirds percent copper sulfate ointment on early forms of follicular conjunctivitis with excellent results.

Medicinal Dyes

One percent aqueous solutions of methylene blue, gentian violet, and congo red were prepared, and each solution was used on two cases of follicular conjunctivitis. The animals were all adult mongrels and each had a well developed case of follicular conjunctivitis. Each case was treated once daily by dropping five minims of the solution being tested in the conjunctival sac. The treatment was continued for a period of ten days. Five days after discontinuation of the treatment, each membrana nictitans was examined for possible results. Changes in the follicles could not be detected in any of the six cases.

CONCLUSIONS

These conclusions are based on the knowledge gained from the microscopic study of five cases of follicular conjunctivitis, the results of experiments on twenty-six dogs, and the treatment of forty-eight cases of follicular conjunctivitis at the Kansas State College veterinary clinic.

1. A discharge from the eye is indicative of ocular disease.

2. The absence of a discharge does not necessarily mean that the eye structures are not diseased.

3. The lamina propria of the conjunctiva of the membrana nictitans normally contains scattered lymphocytic cells.

4. An increase in the lymphocytes in the lamina propria constitutes the first stage of development of follicular conjunctivitis.

5. The pathological lesions of follicular conjunctivitis are commonly found on the inner surface of the membrana nictitans.

6. Lymphocytes, plasma cells, and an occasional eosinophil compose the cellular structure of the lymph follicles found in follicular conjunctivitis.

7. In chronic cases of follicular conjunctivitis, there is a considerable connective tissue proliferation in the lamina propria.

8. Additional work should be done to determine if the condition can be transmitted.

9. Follicular conjunctivitis is not due to bacterial infection.

10. Secondary bacterial infection may occur in advanced cases.

11. There are no demonstrable inclusion bodies in epithelial scrapings of the follicles.

12. The administration of massive doses of vitamin A did not affect the course of the disease.

13. The administration of an anti-allergic, antihistaminic preparation did not affect the course of the disease.

14. Cauterization of the follicles with crystalline copper sulfate is the best treatment for follicular conjunctivitis.

15. Early cases of follicular conjunctivitis can be treated with excellent results by using a one percent solution of copper sulfate in glycerin or a one and two-thirds percent copper sulfate ophthalmic ointment.

16. The solution of copper sulfate will cause a temporary lacrimation.

17. One percent solutions of methylene blue, gentian violet, and congo red are not effective against follicular conjunctivitis.

18. A two percent solution of butyn sulfate is an effective anesthetic to use when treating follicular conjunctivitis.

19. Cases of follicular conjunctivitis should be checked ten to fourteen days after treatment to see if there are any follicles remaining. If follicles are still present, the condition should be treated again.

ACKNOWLEDGMENTS

Recognition and sincere appreciation are given to Dr. R. E. Witter, Dr. E. J. Frick, Dr. L. M. Roderick, and Miss Alice Kimball for valuable suggestions, aid, and laboratory facilities freely offered.

LITERATURE CITED

(1) Nicolas, Eugene.
Veterinary and comparative ophthalmology. Translated by Henry Gray. London. H. K. Brown. 449 p. 1924.

(2) Brumley, Oscar V.
A textbook of the diseases of the small domestic animals, 4th ed. Philadelphia. Leo and Febiger. 345 p. 1943.

(3) Sisson, Septimus.
The anatomy of the domestic animals, 3rd ed. Revised by James D. Grossman. Philadelphia. W. B. Saunders. 262 p. 1938.

(4) Miller, Malcolm E.
Guide to the dissection of the dog. Ithaca. Lithoprinted by Edwards Brothers. Ann Arbor, Michigan. 376-389. 1947.

(5) Maximow, Alexander A. and Wm. Bloom.
A textbook of histology, 4th ed. Philadelphia. W. B. Saunders. 634 p. 1942.

(6) Muller, George and Alexander Glass.
Diseases of the dog and their treatment, 4th ed. Chicago. Alexander Eger. 403 p. 1923.

(7) Sharp, Walter E.
Ophthalmology for veterinarians. Philadelphia and London. W. B. Saunders. 74 p. 1913.

(8) Hawk, Phillip B., Bernard Oser and Wm. Summerson.
Practical physiological chemistry, 12th ed. Philadelphia. Blakiston's. 1187 p. 1947.

(9) Covault, C. H.
Some common diseases of the eye. Veterinary Medicine. 29: 104-109. March, 1934.

(10) Tusak, E. A.
Surgical and medical procedure in treatment of external disease of the eye in veterinary practice. Jour. A. V. M. A. 85: 379-388. Sept. 1934.

(11) Eastman, D. A.
Treatment of the diseases of the eye and accessory organs. North American Veterinarian. 27: 56-57. Feb. 1932.

(12) Urbach, Erick and Phillip Gottlieb.
Allergy, 1st ed. New York. Grune and Stratton. 944 p. 1943.

(13) Witter, R. E.
Personal Communication. March, 1948. School of Veterinary Medicine, Kansas State College.